Specification Amendments:

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[0002] Cables, such as UTP, ScTP, coaxial and fiber optic cables, transmit data, voice, video and/or audio information in the telecommunications industry. Patch panel ~~or~~ and network equipment enclosure ~~and~~ rack systems are well-known in the industry. They manage and organize such cables both to and from such equipment and/or to and from ~~cross-connect systems~~ such patch panels. These systems usually include the standard EIA 19", 23" or other distribution frame rack on which one or more patch panels, network equipment, fiber optic enclosures and the like are mounted. Rack enclosures serve various functions, including their use as slack trays, splice trays, cable organizers and patch panels. These ~~racks~~ rack enclosures also serve as interconnect or cross-connect enclosures when they interface with equipment. Additionally, ~~these racks~~ rack systems may serve as a telecommunications closet, allowing the cables to be terminated, spliced, patched and/or stored at various places along their length.

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[0004] There is a need for a patch panel design that eliminates the necessity for one or more of these ~~external~~ cable management devices.

BRIEF DESCRIPTION OF THE DRAWINGS

B3 cont.

[0012] The foregoing and further objects, features and advantages of the present invention will become apparent from the following description of preferred embodiments with references to the accompanying drawings, wherein:

Fig. 1 shows an exploded isometric view of a first embodiment of an angled patch panel frame according to the present invention and a cable support bar therefor;

Fig. 2 shows a top view of the patch panel frame of Fig. 1;

Fig. 3 shows an exploded view of an insert module loaded with four cable connector modules being inserted into the patch panel frame of Fig. 1;

B3 cncl'd.

Fig. 4 shows the patch panel of ~~Fig. 1~~ Fig. 3 and the cable support bar ~~loaded~~ mounted onto a 19" standard rack;

Fig. 5 is a detailed partial view of the 19" standard rack and patch panel of Fig. 4;

Fig. 6 shows a top view of the patch panel and the 19" standard rack of Fig. 4;

Fig. 7 show an isometric view of a second embodiment of an angled patch panel frame according to the present invention;

Fig. 8 shows ~~the~~ an insert ~~modules~~ module used in the second embodiment of the patch panel; and

Fig. 9 shows an exploded view of an insert module loaded with four cable connector modules being loaded into the second embodiment of the patch panel.

B4 cont

[0014] The patch panel frame 100 includes an outwardly angled central frame 110, a plurality of faceplate openings 120 and a mounting plate 130 at each end with a plurality of mounting apertures 135, as shown in Fig. 1. A flat centerpiece 140 located midway along frame 110 may be provided to space the openings 120 on opposite halves of the central frame 110 from each other. This centerpiece 140 also slightly reduces the depth D of the patch panel by eliminating the angle at a central portion where no openings 120 are located. Patch panel frame 100 is preferably formed of a suitable material, such as metal so as to be self grounding. However, ~~when a separate grounding bar is available,~~ frame 110 may be formed of any suitable rigid material, such as many plastics or composites. A separate or integral cable support bar 200 may be provided on a rear side of the patch panel. Cable support bar 200 includes a bar portion 210 and mounting plates 220.

[0015] Both the patch panel frame 100 and cable support bar 200 are designed to mount on a rack. Patch panel frame 100 can be any size, but preferably is sized with a width W to fit within a conventional 19" or 23" EIA network rack that has spaced vertical rails or legs 510 that allow the

mounting of various rack elements thereon (see Figs. 4-5). The patch panel can occupy a single rack unit height of 1.75" (4.45 cm) or multiple rack unit height, such as the two rack unit height illustrated (3.5" or 8.9 cm). The rack 500 should have various mounting openings 520 or comparable devices to facilitate equipment mounting. When mounted, patch panel frame 100 protrudes out from the front of the rack 500 by a distance D of several inches, as shown in Figs. 2 and 6, due to the outwardly angled frame 110.

B4 cont'd.

[0017] Patch panel frame 100 is angled outwardly in a generally inverted V-shape. Fig. 2 shows a top view of the angled patch panel frame 100. Each half of the ~~patch panel~~ central frame 110 is preferably a mirror image and angled from the other by an angle ϕ,~~°~~which is an obtuse angle of a suitable angle of between about 90° and 180°, preferably an angle of between about 100° to 140°, and more preferably between about 110° and 130°. The illustrative embodiment shown has an angle ϕ of about 120.° This allows cables attached to the front of the patch panel to flow directly to one or more vertical cable managers located adjacent the network rack.

B5

[0019] Patch panel frame 100 has a plurality of faceplate openings 120 that receive insert modules 300, as shown in Fig. 3. The insert modules 300 are sized to fit within openings 120, preferably by snap fit. However, rather than replaceable modules, modules 300 may be integrated into frame 110. The modules and openings may be multiple rack unit heights or may be sized as a single rack unit height, as shown. In the first illustrative exemplary embodiment, patch panel frame 100 has twelve faceplate openings 120. These twelve faceplate openings 120 allow twelve insert modules 300 to be inserted into the patch panel frame 100, as shown in Fig. 3.

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[0022] There are several advantages to the inventive patch panel. By making the frame angled outwardly in an inverted V-shape, ~~the cable connector modules when inserted into the~~

B7 cont.

~~openings all face~~ the axis of each cable connector is at the acute angle θ relative to a common central axis (parallel to the depth direction D). This provides front connector surfaces that are better oriented relative to front corners of the rack rails 510, where vertical cable managers or ducts 530 are provided that contain cables 540 that mate with front sides of various ones of the cable connector modules 400 as shown in Fig. 6. In particular, the angled frame 110 provides a connector surface that is at a reduced angle relative to an exit direction of the cables exiting the vertical cable manager as compared to conventional patch panels. That is, prior art, flat-faced patch panels which were ~~located~~ oriented substantially parallel to the exit direction and required ~~a~~ one or more 90° cable bends for connection. ~~This requires~~ In general practice, this required an external horizontal cable manager to control the bends and provide a minimum bend radius. However, as the inventive patch panel has surfaces that intersect this exit direction (direction X in Fig. 6) at ~~a strong~~ an acute angle, the bend necessary to achieve connection is substantially less than 90° as shown. This reduces or eliminates the need for additional horizontal cable management adjacent to the patch panel to guide exiting cables from the vertical cable managers 530 to the ~~patch panel 100~~ individual connector modules 400 as ~~the cables~~ each cable 540 ~~more naturally flow from the vertical ducts 530 to the individual connector modules 400~~ is routed directly from each connector module 400 to the adjacent vertical duct 530.

[0023] Additionally, this structure results in slightly shorter patch cable lengths than before. Moreover, the outwardly angled frame 110 provides increased space behind patch panel frame 100 for housing the cabling. That is, as shown in Fig. 6, a conventional flat-faced patch panel would be flush to the rack rails 510 and would thus only provide an area of the inner rectangle between rails

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510. However, with the angled patch panel, the receiving area is this inner rectangle plus the triangular area defined by the outwardly extending frame of patch panel 100.

B8 cont.

[0027] Cable support bar 200 is preferably separate from patch panel frame 100, but may be integrally formed therewith if desired. Cable support bar 200 may be attached to rack 500 using mounting apertures 225 either from the front when the patch panel frame 100 is attached, or from the back after the patch panel frame 100 has been attached. Attaching the cable support bar 200 from the back allows the end user to install the cable support bar 200 after all of the connectors have been terminated, thus eliminating any interference from the cable support bar 200 when terminating the connectors.

[0028] In a second embodiment of the present invention shown in Figs. 7-9, a variation in configuration is provided. Patch panel frame 700 is angled with angles ϕ and θ as in the first illustrative embodiment. However, for this embodiment, there are only six faceplate openings 720 in frame 710 that allow for ~~twelve-pack~~ twelve-pack insert modules 800 to be inserted therein. These modules occupy a double rack height. Like the previous embodiment, mounting plates 730 are provided for mounting the patch panel to a rack and a flat centerpiece 740 may be provided.

[0029] The twelve-pack insert modules 800 for the second embodiment of the present invention are shown in Fig. 8. While more or less connector modules could be provided, the illustrative insert modules 800 are capable of receiving up to twelve single-spaced cable connector modules 900. To allow a snap fit within openings 720, insert modules 800 have four 'upside down' snaps 810, as shown in Fig. 8, which hold insert module 800 to patch panel frame 700. However, other methods of affixing insert modules 800 to openings 720 are contemplated.

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[0030] Fig. 9 shows an exploded view of an insert module 800 loaded with four exemplary cable connector modules 900 being positioned for mounting into patch panel frame 700. Five other insert modules 800 with cable connector modules 900 are shown already loaded into patch panel 700. While not necessary, the illustrative patch panel 700 covers two rack units as in the previous embodiment and fits into a standard 19" network rack. With this configuration, a capacity of 72 cable connector ports can be achieved in a two rack height patch panel.